

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference ACH63901WO00	FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/GB2004/003450	International filing date (day/month/year) 11.08.2004	Priority date (day/month/year) 13.08.2003	
International Patent Classification (IPC) or national classification and IPC F03G7/00			
Applicant UNIVERSITY OF SURREY et al.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 4 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 10.06.2005		Date of completion of this report 29.12.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Giorgini, G Telephone No. +49 89 2399-7244	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/003450

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-27 as originally filed

Claims, Numbers

1-21 received on 13.06.2005 with letter of 09.06.2005

Drawings, Sheets

1/3-3/3 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/003450

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-21
	No: Claims	
Inventive step (IS)	Yes: Claims	1-21
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-21
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/GB2004/003450

Reference is made to the following document:

D1: US 3 906 250 A

V.1 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows an apparatus and a process for generating power by utilizing pressure-retarded osmosis (see fig. 10).

In D1 the pressure of the pressurized solution (128) is transferred to another liquid via a pressure exchange system and not, as instead specified by claim 1, by means of a selective membrane positioned between a liquid and the solution having a higher osmotic potential.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as increase the efficiency of the osmotic plant.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) as the skilled person, starting from the process of D1, would not take into consideration the possibility of modifying it in the direction of claim 1 as this would imply an overall rearrangement of the process and the provision of new apparatuses.

V.2 Claims 2 to 21 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

V.3 The following objections are nevertheless raised:

- Contrary to the requirements of Rule 6.2(b) PCT, the claims do not contain reference signs.
- Independent claim 1 is not in the correct two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor are these documents identified therein.

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Claims

1. A process for driving a prime mover, said process
5 comprising
a) positioning a selective membrane between a liquid
and a solution having a higher osmotic potential than the
liquid, such that the solution becomes pressurised by the
influx of liquid across the membrane,
10 b) transferring the pressure generated in the solution
to another liquid via a pressure exchange system to drive a
prime mover,
c) recovering the solution,
d) separating at least some of the solvent from the
15 solution to form a residual product, and
e) recycling the separated solvent and/or the residual
product of step d) to step a).
2. A process as claimed in claim 1, wherein the prime
20 mover is a rotary prime mover.
3. A process as claimed in any one of the preceding
claims, wherein the solution is an aqueous solution.
- 25 4. A process as claimed in any one of the preceding
claims, wherein the solution is solution of a salt selected
from sodium chloride, potassium chloride, potassium nitrate,
magnesium sulfate, magnesium chloride, sodium sulfate,
calcium chloride, sodium carbonate, disodium
30 hydrogenphosphate and potassium alum.

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5. A process as claimed in claim 3 wherein the aqueous solution is formed by dissolving ammonia and carbon dioxide in water.

5 6. A process as claimed in claim 5, which is an aqueous solution of ammonia, carbon dioxide, ammonium carbonate, ammonium bicarbonate and ammonium carbamates.

10 7. A process as claimed in any one of the preceding claims, wherein the solution has a solute concentration of 1 to 400 weight %.

15 8. A process as claimed in any one of the preceding claims, wherein the liquid is selected from the group consisting of freshwater, seawater, brackish water and a waste stream from an industrial or agricultural process.

20 9. A process as claimed in any one of the preceding claims, wherein the liquid is or comprises the same solvent as the solvent of the solution.

25 10. A process as claimed in any one of the preceding claims, wherein solvent is removed in step d) by a thermal and/or membrane separation method.

11. A process as claimed in claim 11, wherein the solvent is removed using a method selected from evaporation, distillation and crystallization.

30 12. A process as claimed in claim 11, wherein the solvent is removed by at least one method selected from multi-stage

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flash distillation, multi-effect distillation, mechanical vapour compression and rapid spray desalination.

13. A process as claimed in claim 10, wherein the solvent
5 is removed by at least one method selected from ion-exchange, electrodialysis nanofiltration and osmosis.

14. A process as claimed in any one of the preceding
10 claims, wherein the energy required to remove solvent in step d) is provided by the wind power, thermal energy of the surrounding environment, solar energy, geothermal energy, energy from a biological process, energy from the combustion of fuel and/or excess heat from power plants and other industrial processes.

15
15. A process as claimed in any one of the preceding
claims, wherein at least some of the solvent recovered in
step d) is recycled to a liquid for step a).

20 16. A process as claimed in any one of the preceding
claims, which comprises using the pressure generated in the
solution to transfer the solution to an elevated location,
and using the potential energy of the elevated solution to
drive the prime mover.

25
17. A process as claimed in any one of the preceding
claims, wherein the solution from step a) is transferred to
an elevated height where the ambient temperature is
(i) low enough to crystallize at least some of the solute in
30 the solution, or
(ii) below the freezing point of the solvent to crystallize
the solvent,


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such that the solution is separated into a portion having a low solute concentration and a portion having a high solute concentration.

- 5 18. A process as claimed in claim 18, wherein each of said portions is returned to ground level, such that the potential energy of each of the portions can be used to drive the prime mover.
- 10 19. A process as claimed in any one of the preceding claims, wherein the thermal energy required to separate the solvent from the solution in step d) is provided by the compression and decompression of gas.
- 15 20. A process as claimed in any one of the preceding claims, wherein the selective membrane of step a) has an average pore size of 1 to 60 Angstroms, preferably 12 to 50 Angstroms.
- 20 21. A process as claimed in any one of the preceding claims, wherein the pressurised solution from step (a) is positioned on one side of a further selective membrane, and a further solution having a higher osmotic potential than the pressurised solution is placed on the other side of the
- 25 membrane, such that the further solution becomes pressurised by the influx of liquid across the membrane.

642478; HMC; RL

VIII-4-1	<p>Declaration: Inventorship (only for the purposes of the designation of the United States of America) Declaration of Inventorship (Rules 4.17(iv) and 51bis.1(a)(iv)) for the purposes of the designation of the United States of America:</p>	<p>I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.</p> <p>This declaration is directed to the international application of which it forms a part (if filing declaration with application).</p> <p>I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.</p> <p>I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications", by application number, country or Member of the World Trade Organization, day, month, and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.</p>
VIII-4-1-1	Prior applications:	0319042.8, GB, 13 August 2003 (13.08.2003)

		<p>I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.</p> <p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.</p>
VIII-4-1-1-1	Name (LAST, First)	AL-MAYAH, Abdulsalam
VIII-4-1-1-2	Residence: (city and either US State, if applicable, or country)	Worcester Park, United Kingdom
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VIII-4-1-1-4	Citizenship:	IQ
VIII-4-1-1-5	Inventor's Signature: (if not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)	x 
VIII-4-1-1-6	Date: (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)	19/08/04

VIII-4-1-2-1	Name (LAST, First)	SHARIF, Adel
VIII-4-1-2-2	Residence: (city and either US State, if applicable, or country)	Guildford, United Kingdom
VIII-4-1-2-3	Mailing address:	School of Engineering University of Surrey Guildford, Surrey GU2 7XH United Kingdom
VIII-4-1-2-4	Citizenship:	GB
VIII-4-1-2-5	Inventor's Signature: (If not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)	x 
VIII-4-1-2-6	Date (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)	x 19.8.2004